VOLUME 23, NO. 6 • NOVEMBER/DECEMBER 2002 (PUB-439)

BUILDING ENERGY SIMULATION

For Users of EnergyPlus, SPARK, DOE-2, BLAST, Genopt, Building Design Advisor, ENERGY-10 and their Derivatives

User News

Features

Software

Departments

EnergyPlus Version 1.0.3 Released

To download a free copy of the program go to

www.energyplus.gov

New Features in EnergyPlus Version 1.0.3

- Composite Constructions data set
- Variable-Speed Fans
- Cooling Tower improvements
- Many COMIS improvements (e.g., air flow through interzone windows and doors, venting through openable doors, add "no vent" strategy)
- Pond heat exchanger
- Ground surface heat exchanger
- Coldest-Zone supply air set point strategy
- Atmospheric pollution calculation
- Design Day "inputs" from weather files
- Entire Design Conditions produced as Location-Design Day combo dataset file
- New input file example for each new feature
- Weather data interpolation (from hourly to time step)
- Improved reporting (e.g., Weather statistics)
- Search capability (Acrobat index) for all documentation
- Improved documentation (Output Details document, expanded Input Output Reference and Engineering Reference, Auxiliary Programs)

EnergyPlus Training for Experienced Modelers

January 29-31, 2003, Chicago, Illinois, USA
An EnergyPlus training course is being offered immediately following the Chicago ASHRAE meeting in January.
The course schedule is:
Wednesday, January 29, 2:00 to 6:00 pm
Thursday, January 30, 8:30 am to 5:30 pm
Friday, January 31, 8:30 am to 1:00 pm
This workshop will introduce EnergyPlus to experienced modelers who are familiar with the basic concepts of energy simulation. The course will cover the mechanics of using EnergyPlus with an emphasis on aspects of EnergyPlus that differ substantially from other common modeling tools (e.g., DOE-2 and BLAST), such as the use of a sub-hour time-steps, the integrated simulation of loads, systems and plant; and defining fluid and air loops. Bring your own laptop for the hands-on workshop sessions. The course will be held in "the loop" in Chicago at the Crowne Plaza Silversmith, 10 South Wabash Avenue (1 block north of the Palmer House Hilton which is the ASHRAE headquarters hotel). For more details please see http://www.gard.com/training.htm

Ask An EnergyPlus Expert

Question: Surface Vertices

Following the convention in the object SurfaceGeometry, from which side do the surfaces need to be faced: inside or outside? And what about floor and ceiling?

Answer:

The surface geometry rules are applied when viewing a surface from its exterior side, as if you are standing outside the zone looking at a surface.

For ceilings, view from above, for floors, view from below. The choice of which vertex is the starting point is arbitrary. Any corner may be selected, but you must follow the correct clockwise or counterclockwise order for the remaining vertices. An implied azimuth is computed based on your selection of starting vertex.

To verify your geometry, request the surface details report: REPORT, Surfaces, Details;

This produces a summary of all surfaces with length, width, tilt, and azimuth in the eio output file. For ease of reading, paste the report into a spreadsheet program and separate on commas.

The IOReference states:
Field: VertexEntry

> Surfaces are always specified as being viewed from the outside of the zone to which they belong. (Shading surfaces are specified slightly differently and are discussed under the particular types). EnergyPlus needs to know whether the surfaces are being specified in counterclockwise or clockwise order (from the SurfaceStartingPosition). EnergyPlus uses this to determine the outward facing normal for the surface (which is the facing angle of the surface very important in shading and shadowing calculations.

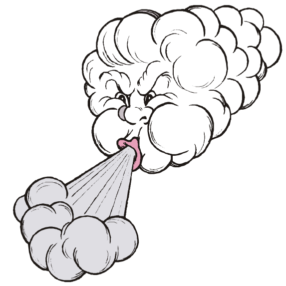
Surfaces are always specified from the "outside" of the surface.

EnergyPlus is being developed by University of Illinois, CERL, and Lawrence Berkeley National Laboratory, with the assistance of the Florida Solar Energy Center, GARD Analytics, the University of Wisconsin, Oklahoma State University and others. Development of EnergyPlus is supported by the U. S. Department of Energy, Dru Crawley, Program Manager.

Join the EnergyPlus User Group

The developers of EnergyPlus have formed a support group to foster discussion and maintain an archive of information for program Users. We invite questions about program usage and suggestions for improvement to the code. Go to **groups.yahoo.com/group/EnergyPlus_Support/**

EnergyPlus Weather Data



The EnergyPlus development team is pleased to announce that our web site now offers more than 570 weather locations available for download and ready to use with EnergyPlus. There are 275 locations in the United States, 16 California thermal zones, 55 Canadian locations, and 233 international locations in more than 80 countries.

Go to www.energyplus.gov

On the right side, under Weather Data, click on one of the following links: USA, California, Canada or International.

We recommend that you also download the weather utility RPT file for each location. The RPT file includes design data where available, statistics for the weather file, including typical and extreme periods (hottest summer week, coldest winter week, typical spring week, etc), Koppen climate classification, heating and cooling degree days, monthly average minimum and maximum dry bulb and dew point temperatures, undisturbed ground temperatures, direct and diffuse solar radiation, relative humidity, and wind speed and direction.

GenOpt 1.1.2

Generic Optimization Program

GenOpt *is a multi-parameter optimization program; it automatically finds the values of user-selected design parameters that minimize a cost function, such as annual energy use, calculated by an external simulation program like EnergyPlus, SPARK, DOE-2, BLAST, TRACE, TRNSYS, etc.*

GenOpt *can be used with any simulation program that has text-based input and output. It also offers an interface for adding custom optimization algorithms to its library.*

Release of GenOpt 1.1.2

GenOpt 1.1.2 fixes problems in reading simulation output files where the objective function value is followed by a comma. Such output strings can be found, for example, in some EnergyPlus outputs.

Also, a method called 'postProcessObjectiveFunction(int, double[] f)' has been added to the file named 'Optimizer.java'. You can modify this function to easily implement post-processing of the objective function value, such as adding two outputs to seek the minimum of the sum of the two outputs.

Example files have been added to the ***GenOpt*** web page (http://SimulationResearch.lbl.gov > GenOpt) to help users set up the program to optimize EnergyPlus simulations. ***GenOpt*** input files still have the same syntax as in version 1.1.1. Therefore, your ***GenOpt*** input files are compatible with the new version.

GenOpt 1.1.2 **(with user manual) may be downloaded free of charge from**

http://SimulationResearch.lbl.gov > GenOpt

VisualDOE 3.1 – A New Tool for Green Building Design

Eley Associates is pleased to announce Version 3.1 of VisualDOE, a program for performing whole-building energy analysis using DOE-2.1E on PCs running MS Windows 95/98/NT/Me/2000/XP.

VisualDOE 3.1 is a new green-building design tool that allows users to evaluate energy and demand impacts of design alternatives. The program covers all major building systems, including building envelope, lighting, daylighting, water heating, HVAC and central plant.

The first release of VisualDOE in 1994 dramatically reduced the time required to perform accurate energy simulations. Version 3.1 takes this ease-of-use and power to a new level. The program is targeted for architects, engineers, MEP firms, energy consultants, utilities, national laboratories, universities, energy service companies, HVAC equipment manufacturers, and building product manufacturers.

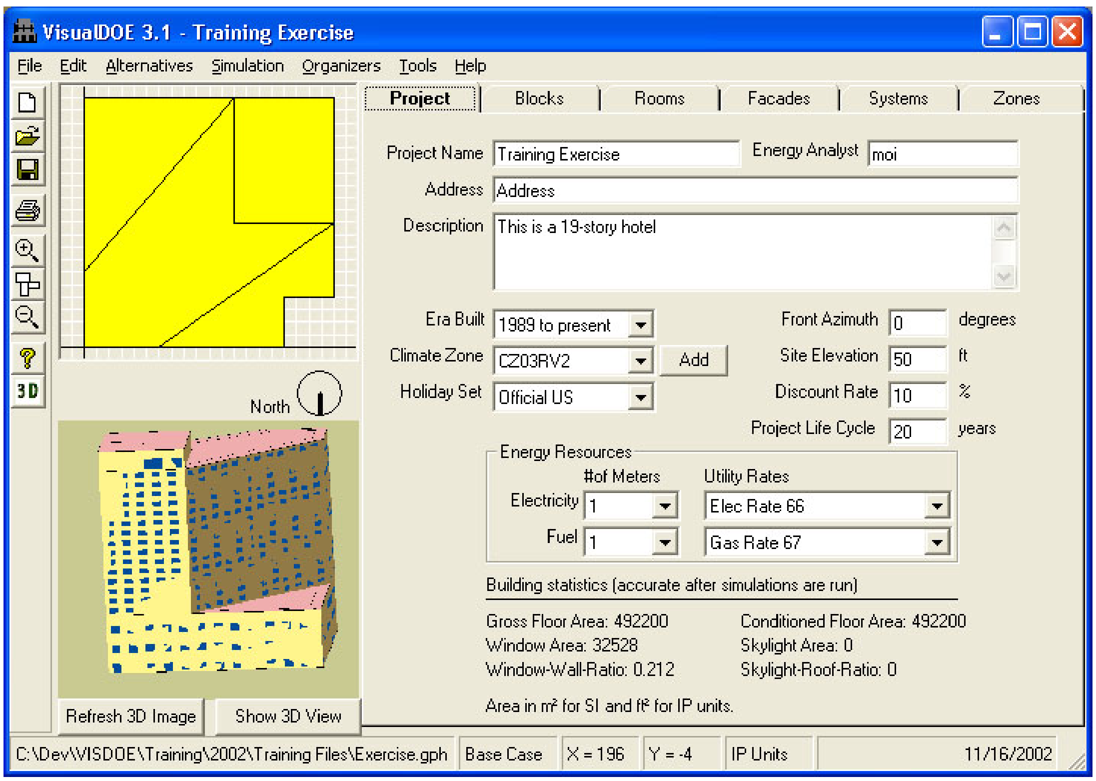
Features in VisualDOE 3.1

- Faster modeling and easier simulation results diagnosis
- LEED style end-use report
- Life-cycle cost analysis of design alternatives
- Supports both SI (metric) and IP units. All reports are revised for SI units
- Free LiveUpdate via the internet to download and install new features
- Modeling Tips to save your time and help diagnose simulation results
- Create up to 99 design alternatives within a project file
- Weather File Converter to pack and unpack DOE-2 weather files
- Create a big energy model with up to 1024 zones and 256 systems
- Re-use data from libraries, templates, and previous projects
- Show building statistics while you build an energy model
- Improved custom block editor and DXF file import to create complicated building shapes
- New 3D view controls
- Enhanced VisualDOE Reports for more useful information of the building, zones and systems
- Share library file to make VisualDOE network compatible
- Export simulation reports to RTF or PDF files
- Complete PDF documentation of DOE-2.1E and VisualDOE
- One-stop editor showing files of input, BDL, output, hourly reports, and weather statistics
- Flexible data input of room internal heat gains in either power density or total power use
- Flexible data input of zone air flow. Air flow autosized or manually sized
- Autosize or manually size systems and central plants
- Define source energy use and process loads of a room
- Adds escalation rate at the utility rate editor for life-cycle cost calculation
- Adds emissivity to the outside surface of a construction under construction editor
- Timely updated user resources and online technical support
- Hundreds of weather files for US and international countries
- Share your VisualDOE experience with ~1,500 users in more than 35 countries
- Periodic professional training seminars
- Future integration of other calculation engines like EnergyPlus

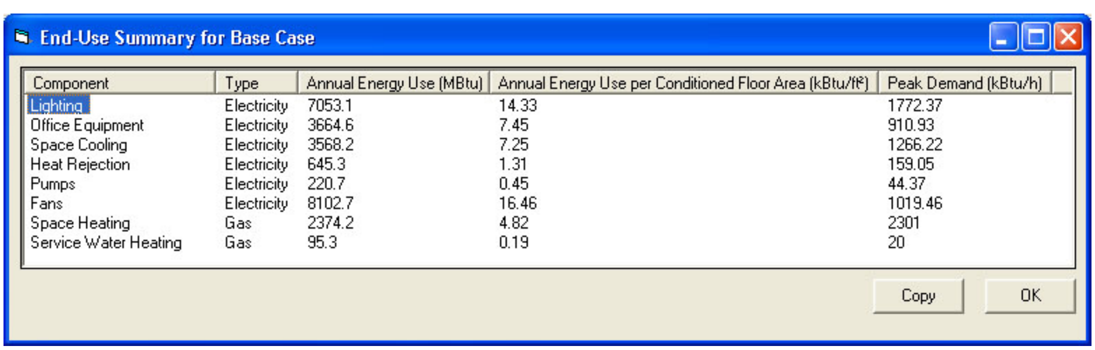
Ordering Information

Eley Associates offers a flexible licensing policy for different types of users. For license details, free demo download and ordering, please visit www.eley.com or contact:
Eley Associates
142 Minna Street, Second Floor
San Francisco, CA 94105
Phone: (415) 957-1977 Fax: (415) 957-1381
Email: sales@eley.com, support@eley.com

VisualDOE 3.1 Interface – Sample Screen Shots

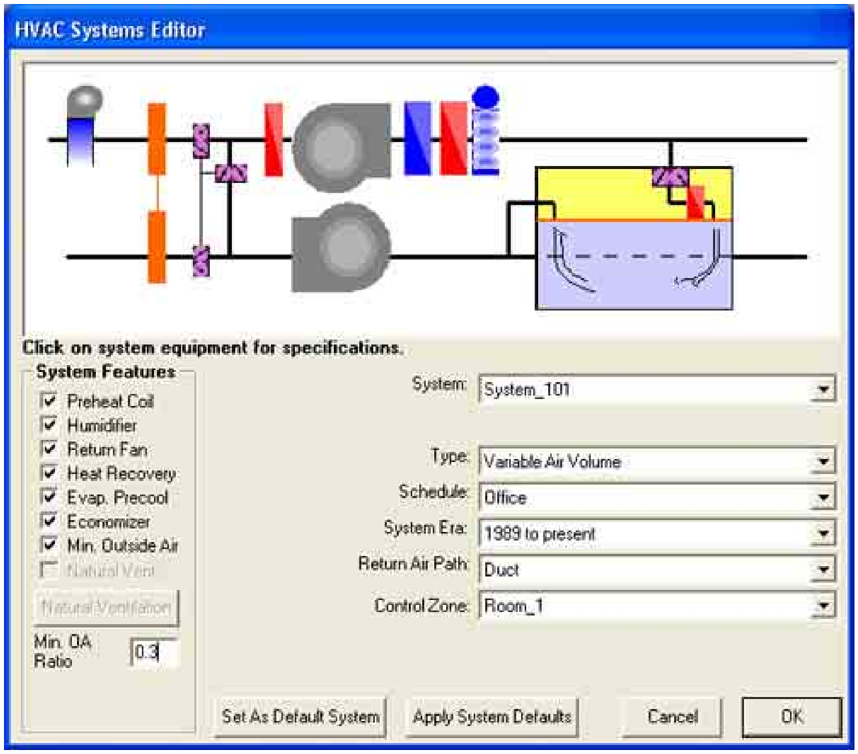


VisualDOE 3.1 Main Form

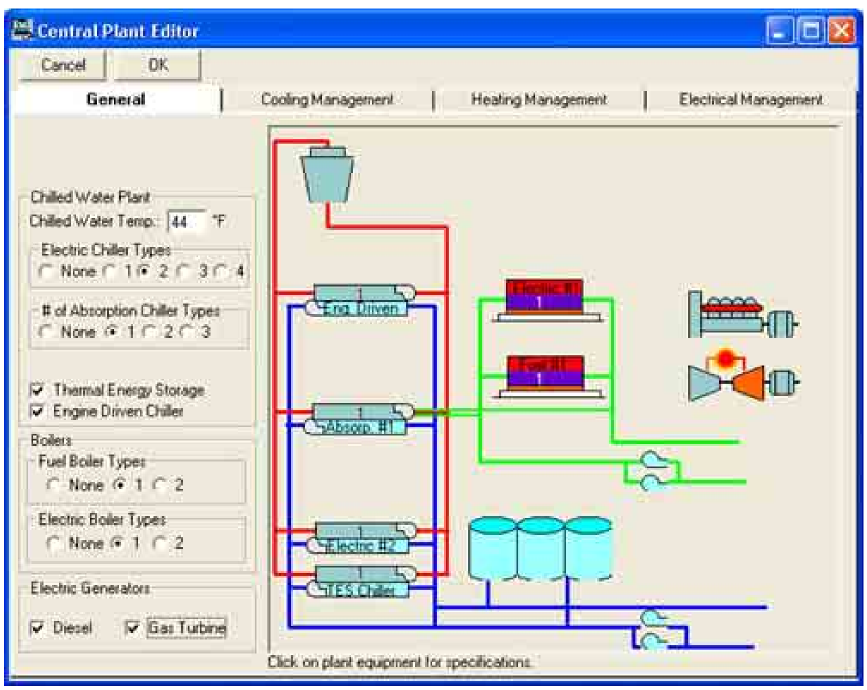


Component	Type	Annual Energy Use (MBtu)	Annual Energy Use per Conditioned Floor Area (kBtu/ft²)	Peak Demand (kBtu/h)
Lighting	Electricity	7053.1	14.33	1772.37
Office Equipment	Electricity	3664.6	7.45	910.93
Space Cooling	Electricity	3568.2	7.25	1266.22
Heat Rejection	Electricity	645.3	1.31	159.05
Pumps	Electricity	220.7	0.45	44.37
Fans	Electricity	8102.7	16.46	1019.46
Space Heating	Gas	2374.2	4.82	2301
Service Water Heating	Gas	95.3	0.19	20

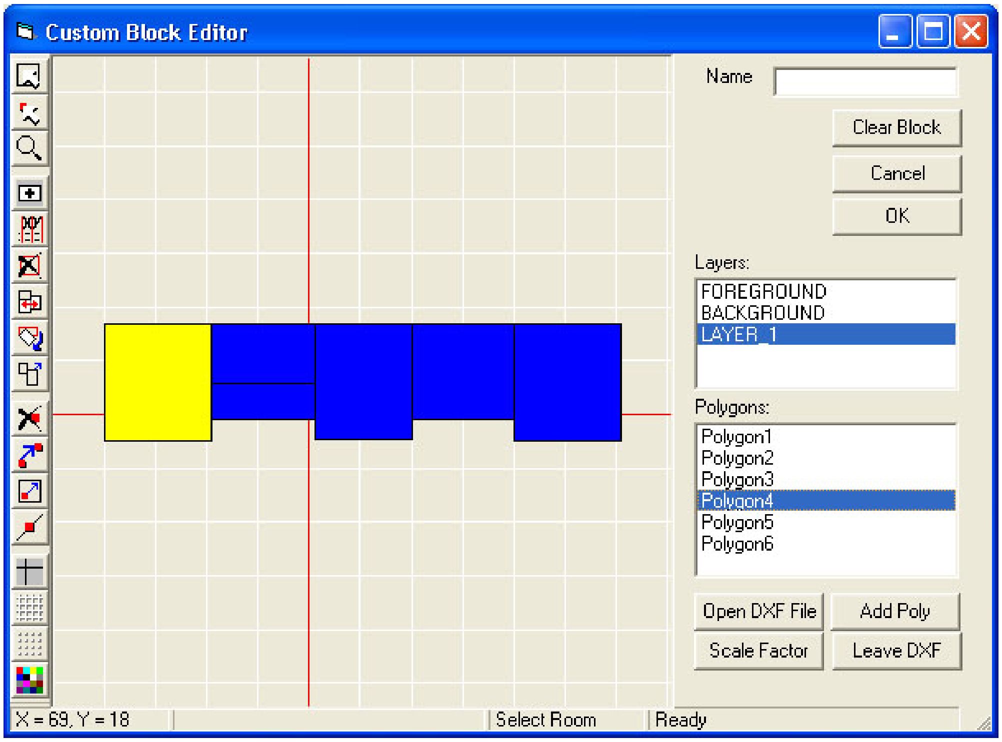
Reports – LEED Style



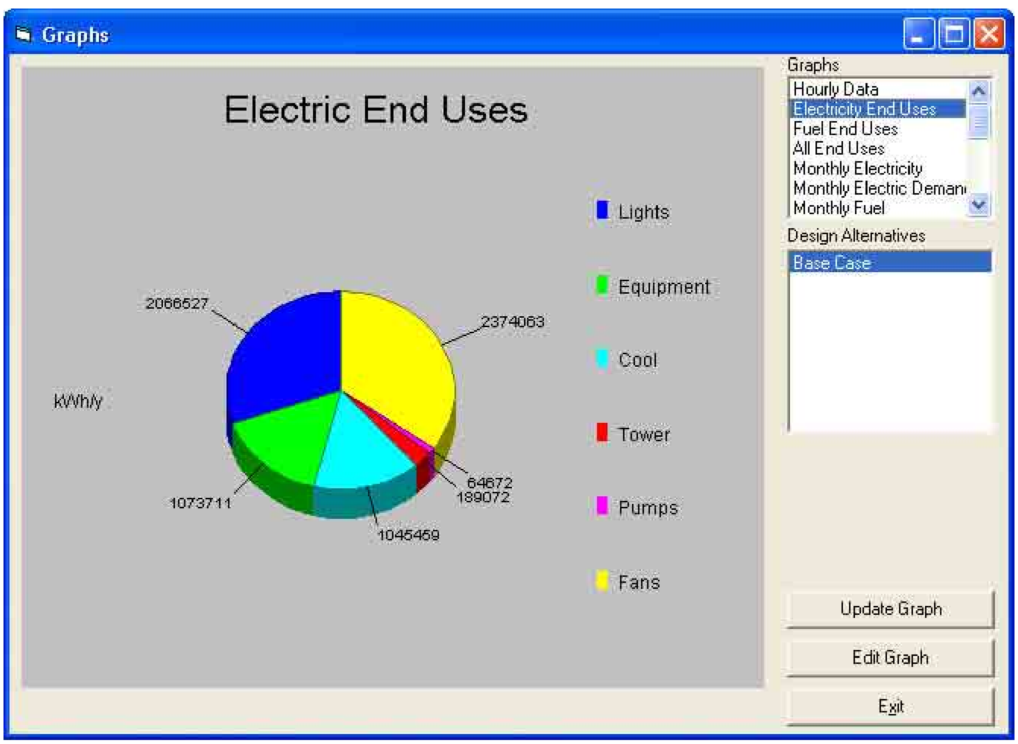
HVAC System Editor



Central Plant Editor



Custom Block Editor – DXF Import



Reports – End-Use

VisualDOE 3.1 - Systems Summary November 16, 2002

Project Information
Name: Training Exercise
Address: Address
Description: This is a 19-story hotel
Analysis done by: moi @ Eley Associates
Project File: c:\dev\visdoe\training\2002\training files\exercise.gph
Case Name: Base Case
Case Description: Base Case
Number of Systems: 9

Systems Summary

Name	Type	Cond. Area (ft²)	Supply (CFM)	Min. OA	Cooling Cap (kBtu/h)	Heating Cap (kBtu/h)	Cooling Peak (kBtu/h)	Heating Peak (kBtu/h)	Cooling Energy (MBtu)	Heating Energy (MBtu)
Asm VAV	VAVS	115200	120000	0.307	5465.6	0	2174.1	1092.6	2553	237
1Guest Room FPFC	FPFC	7500	3750	0.12	0	0	87.6	63	100	53
Restaurant CAV	RHFS	8000	15000	0.393	685.5	0	611.2	314.2	1111	1216
2Guest Room FPFC	FPFC	7500	3750	0.12	0	0	155	67	256	43
3Guest Room FPFC	FPFC	39000	19500	0.12	0	0	607.5	168.7	1151	39
4Guest Room FPFC	FPFC	10500	5250	0.12	0	0	205.2	75.7	412	19
5Guest Room FPFC	FPFC	13500	6750	0.12	0	0	240.4	87	439	32
6Guest Room FPFC	FPFC	36000	18000	0.12	0	0	510	159.2	593	57
7Guest Room FPFC	FPFC	255000	127500	0.12	0	0	1642.1	0	6326	0

Systems Summary per Conditioned Area

Name	Type	Cond. Area (ft²)	Supply (CFM/ft²)	Min. OA	Cooling Cap (Btu/h/ft²)	Heating Cap (Btu/h/ft²)	Cooling Peak (Btu/h/ft²)	Heating Peak (Btu/h/ft²)	Cooling Energy (kBtu/ft²)	Heating Energy (kBtu/ft²)
Asm VAV	VAVS	115200	1.042	0.307	47	0	19	9	22	2
1Guest Room FPFC	FPFC	7500	0.5	0.12	0	0	12	8	13	7
Restaurant CAV	RHFS	8000	1.875	0.393	86	0	76	39	139	152
2Guest Room FPFC	FPFC	7500	0.5	0.12	0	0	21	9	34	6
3Guest Room FPFC	FPFC	39000	0.5	0.12	0	0	16	4	30	1
4Guest Room FPFC	FPFC	10500	0.5	0.12	0	0	20	7	39	2
5Guest Room FPFC	FPFC	13500	0.5	0.12	0	0	18	6	33	2
6Guest Room FPFC	FPFC	36000	0.5	0.12	0	0	14	4	16	2
7Guest Room FPFC	FPFC	255000	0.5	0.12	0	0	6	0	25	0

Reports – Systems Summary

VisualDOE 3.1 - Results November 23, 2002

Energy Cost Summary ($/y)

Alternative	Total Electric	Total Fuel	Total Utility	Incremental First Cost	Life Cycle Cost*
Total Energy Costs ($/y)					
As-Designed	$637,529	$45,921	$683,450	$0	$5,818,595
EEM2 - Efficient Lighting	$523,464	$46,964	$570,428	$50,000	$4,906,375
EEM10 - Cool Roof	$506,926	$49,087	$556,013	$0	$4,733,652
Incremental Energy Savings ($/y) (compared with previous alternative, negative savings represent increases)					
EEM2 - Efficient Lighting	$114,065	$-1,043	$113,022	$-50,000	$912,220
EEM10 - Cool Roof	$16,538	$-2,123	$14,415	$50,000	$172,723

* 20 year life cycle w/ 10% discount rate.

Results – Life Cycle Cost

Building Design Advisor 3.0

Decision making through the integrated use of multiple simulation tools and databases

The **Building Design Advisor (BDA)** is a Windows® program that addresses the needs of building decision-makers from the initial, schematic phases of building design through the detailed specification of building components and systems. The BDA is built around an object-oriented representation of the building and its context, which is mapped onto the corresponding representations of multiple tools and databases. It then acts as a ***data manager*** and ***process controller***, automatically preparing input to simulation tools and integrating their output in ways that support multi-criterion decision-making. BDA 3.0 includes links to **SGE** (a grapical editor for schematic design), **DElight** (a daylighting simulation tool), **ECM** (a simplified electric lighting simulation tool) and the **DOE-2.1E** building energy simulation program.

ECM, an **electric lighting simulation tool**, is integrated through BDA with DOE-2. BDA's Schematic Graphic Editor (**SGE**) allows placement of electric lighting luminaires and specification of reference points for daylight-based electric lighting controls. Moreover, BDA has the capability of **running DOE-2 parametrically** to generate a plot that shows the relationship between effective aperture and energy requirements. There is also the added functionality of working with either **English units or Metric units**.

Current development efforts are focused on the completion of BDA 3.1, which includes computation of operating energy costs. To download a free copy of BDA 3.0, go to

http://gaia.lbl.gov/BDA/index.html

The BDA source code is available for licensing; if interested, please contact Dr. Papamichael at K_Papamichael@lbl.gov.

For Beta Testing of BDA 3.1, contact Kosta Papamichael at k_papamichael@lbl.gov.

Join the BLDG-SIM Mailing List

BLDG-SIM is a mailing list for users of building energy simulation programs like EnergyPlus, DOE-2, Trace-600, HAP, BLAST, ESP, SERIRES, TRNSYS, TASE, ENERGY-10 and others. Because building simulation professionals are located worldwide, the BLDG-SIM list is an attempt to foster the development of a community of those users. Users of all levels of expertise are welcome and are encouraged to share their questions and insights about these programs.

The web page for BLDG-SIM is http://www.gard.com/bldg-sim.htm

Jason Glazer, P.E., Of GARD Analytics, Inc. Is the list administrator (jglazer@gard.com).

DoeRayMe

You are invited to test **DoeRayMe**, a new DOE-2.1E screening tool application currently being developed by Jason Glazer, P. E., of GARD Analytics, Inc. **DoeRayMe** is a simple and flexible interface that uses a specially developed DOE-2 input file (template) that contains special codes describing the parameters available to

be changed in the user interface. This allows new screening tools to be developed by any DOE-2 user. Please visit the **DoeRayMe** web site at http://www.gard.com/DoeRayMe.

DOE-2 Puzzler

MIN-SUPPLY-SCH vs. MIN-AIR-SCH

What's the Difference?

Question:
I'm seeing strange values of TCMIN in my hourly output from systems. Why is TCMIN often below 32ºF?

Answer:

I found the cause of the unphysical (less than freezing) TCMIN you were seeing in your DOE-2 runs.
In DOE-2 TCMIN is calculated as:

TCMIN = PASTM -(QCS/(CONS(1)*<PASTCFM>)) (1)

where PASTM is last hour's mixed air temperature, QCS is the sensible capacity of the cooling coil this hour, and PASTCFM is last hour's flow rate. Obviously this formula can give quite a low TCMIN if there is a normal amount of capacity. TCMIN is then adjusted for fan heat and duct losses. Finally limits are applied to TCMIN as follows:

TCMIN=AMAX1(TCMIN,AMIN1(PASTM+DTF,<MIN-SUPPLY-T>+TCR)) (2)

where MIN-SUPPLY-T is the user input minimum possible supply temperature. DTF is the fan and duct loss adjustment, TCR is the cooling supply temperature throttling range. So equation (2) overrides the values calculated in equation (1).

You input MIN-SUPPLY-T=55 and the hourly reports show that the mixed air temperature is normal. So what went wrong? You also input MIN-SUPPLY-SCH=LAB-MCR-SCH and LAB-MCR-SCH=SCH

```
THRU DEC 31
        (WD)  (1,24)(0.50)
   $     (WD)  (1,7)(0.50)
   $          (8,14)(0.50)
   $          (15)(1.000)
   $          (16,18)(0.50)
   $          (19,24)(0.50)
        (WEH)(1,24)(0.50) $(-999)
```

MIN-SUPPLY-SCH is a scheduled value for MIN-SUPPLY-T and its hourly values override MIN-SUPPLY-T. You have set the hourly value of MIN-SUPPLY-T to 0.5ºF. Undoubtedly, you meant to use MIN-AIR-SCH=LAB-MCR-SCH, thus setting a scheduled value for the minimum cfm ratio. Anyway the upshot is that an unphysical input for either MIN-SUPPLY-T or MIN-SUPPLY-SCH will yield unphysical values for TCMIN. MIN-SUPPLY-T defaults to 55, so a minimal input will be okay. MIN-SUPPLY-SCH is documented on page 3.127 of the DOE-2.1E Supplement, as follows:

MIN-SUPPLY-SCH: This keyword allows you to specify the value of MIN-SUPPLY-T on an hourly basis to simulate the effect of chilled water reset (or other types of capacity control) coil performance. The coil minimum conditions will be based on the value of this schedule rather than the value of MIN-SUPPLY-T. MIN-SUPPLY-T will be used in design calculations for coil and system component sizing only. The values in the schedule are used to calculate the coil surface conditions (temperature and moisture condensation), but are not used to set the supply air controller (if present) except that the supply temperature cannot go below this value (adjusted for fan heat and duct losses). The value specified in this schedule should be coordinated with the COOL-CONTROL method and related schedules, reset schedules or setpoints, as well as coil performance parameters.

DOE-2 Puzzler

Control of Relative Humidity

Question:
I am having big problems controlling relative humidity. I have modeled a school with SZRH (one zone per system) and, although I have lowered MIN-SUPPLY-T down to 50°F, RH exceeds 50% for too much of the time in high occupancy classrooms (Report SS-N). I have also modeled a low occupancy office building with VVS and the RH scatter plot (Report SS-N) shows most of the occupied hours having RH above 50%. Is there a problem with DOE-2.1E or with me? Perhaps cooling coil simulation is outdated; new installtions often use 6-row coils.

Answer:
I don't think SZRH will give good humidity control since it is a variable temperature system. When the cooling load is low the supply temperature will rise and do little or no dehumidifying. You can use a constant temperature system, such as VAV, or you can specify a humidity controller. Try using MAX-HUMIDITY=50 in the SYSTEM-CONTROL command then try the same thing with VVS. Also you can always change the coil bypass factor to change the coil performance (smaller CBF means more dehumidification).

Outside Air Intake

Question:
Can outside air intake be linked to occupancy? I want to simulate CO2 sensors controlling OAI.

Answer:

No. You have to do this by hand by using the MIN-AIR-SCH to match the occupancy (given by the occupancy schedule).

Question:

Can outside air intake be scheduled? I want to shut it off during unoccupied periods.

Answer:

Yes. The keyword is MIN-AIR-SCH in the SYSTEM-AIR command. A schedule value of 0 means no outside air flow, a value of 1 means 100% outside air. A value of -999. means ignore the scheduled value and do the normal calculation including possible economizer operation.

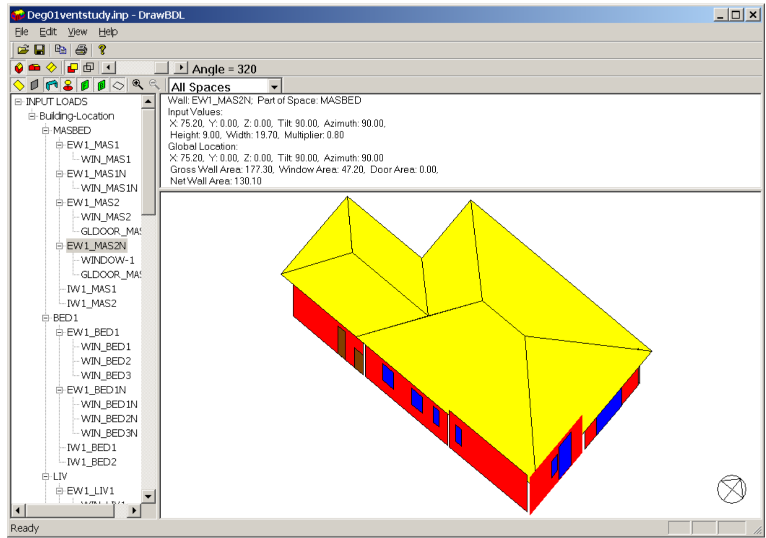
Email your "DOE-2 Puzzler" questions to klellington@lbl.gov

The Building Energy Simulation User News is published bi-monthly and distributed electronically by the Simulation Research Group at Lawrence Berkeley National Laboratory. Direct comments or submissions to Kathy Ellington (KLEllington@lbl.gov). Direct BLAST-related inquiries to the Building Systems Laboratory (support@blast.bso.uiuc.edu).

DrawBDL 3.0

Joe Huang and Associates is pleased to announce Version 3.0 of the *DrawBDL* program for viewing the building geometry in DOE-2 input and output files. We have completely rewritten *DrawBDL* using C++ to run in a native 32 bit environment such as Windows 95/2000/NT. In addition to having a somewhat different look and feel, Version 3.0 has the following improvements:

1. New user interface with a hierarchical tree showing all building surfaces.
2. No limit on the number of building surfaces, except for the amount of memory available on the computer.
3. For building surfaces, the expanded data window shows not only the input values, but also their locations in the global coordinate system; for spaces, the data window shows the gross and net areas of walls, windows, doors, roofs, and skylights.
4. Displays surfaces input as two-dimensional or three-dimensional polygons (please see DOE-2.1E Documentation Update #2 http://SimulationResearch.lbl.gov/dirsoft/21e_update2.pdf for the syntax to input surfaces as polygons).



DrawBDL 3.0

5. Changing the sort order of building surfaces used in the display; this allows users to "touch up" the shaded drawings for use in presentations.
6. Output the surface data in *EnergyPlus* *.idf format. This is helpful for *DrawBDL* users who wish to convert their DOE-2 input files into *EnergyPlus* input files. Since *DrawBDL* reads and stores only building surface data, the converted *EnergyPlus* file is a partial file containing only the inputs for building surfaces.

DrawBDL 3.0 costs $125 plus shipping; for more information or to order, please contact

Joe Huang and Associates
31 Sarah Lane **Phone 925-247-9180**
Moraga CA 94553 **email: tmchow@compuserve.com**

The minutes from the ASHRAE's Honolulu meeting are now on the TC4.7

web page for downloading. They are in Word and Pdf format.

The home page URL is http://www.mae.okstate.edu/tc47/index.html

WINDOW 5.1, THERM 5.1 and Optics 5.1

Updates and Enhancements

WINDOW 5.1

WINDOW 5.1 calculates total window thermal performance indices (i.e. U-values, solar heat gain coefficients, shading coefficients, and visible transmittances) and provides a versatile heat transfer analysis method consistent with the updated rating procedure developed by the National Fenestration Rating Council. The program also has a link to both EnergyPlus and the DOE-2.1E building energy analysis programs. WINDOW 5.1 includes all of the WINDOW 5.0 and 5.02 capabilities, and includes the ability to read the combined Condensation Resistance and U-factor results generated by THERM.

Program Updates

WINDOW 5.1, a significant upgrade to previous versions, offers these new features:

- State of the art Microsoft Windows™ interface
- Updated algorithms for the calculation of total fenestration product U-values and Solar Heat Gain Coefficient consistent with ASHRAE SPC142, ISO15099, and the National Fenestration Rating Council
- A Condensation Resistance Index in accordance with the NFRC 500 Standard
- A surface temperature map
- An integrated database of properties
- Links to other LBNL window analysis software:
  - THERM for calculating 2-D frame and edge effects
  - RESFEN, for calculating the energy effects of windows for US residences
  - Optics 5 for the optical properties of all coated and uncoated glazings, laminates, and applied films

In General

- A New, Copy, Delete, Save and Report buttons to all the Library Detailed view has been added.
- The ability to import and overwrite protected records with protected records from another WINDOW 5.1 database has been added.
- A database "Compacting" feature in the Tools menu has been added; this is useful when records have been deleted.

Optics 5.1

Optics 5.1 allows you to view and modify glazing data in many new and powerful ways. Optics 5.1 is compatible with WINDOW 5.1 and can be downloaded from http://windows.lbl.gov/materials/optics5/default.htm.

Optics 5.1 Features, Corrections, Changes

Glazing Layers

- Manipulating layers (changing thickness, substrate, film and/or coating) can be done inside laminates and glazing systems.
- User-manipulated glazing layers will automatically be assigned an NFRC_ID of 30,000 or higher and the user is forced to change the filename of this layer and/or its substrate to denote that the properties have changed. This will prevent entries in the WINDOW 5.1 database from being overwritten automatically when importing NFRC-accepted files.
- It is now possible to create double-coated glazings, i.e., glazings with a coating on each side. These double-coated glazings can be saved to a database but cannot be manipulated any further after the second coating is applied.
- It is now possible to create glazings with a coating on one side and an applied film on the other side by applying a film to a coated glazing. These special glazings can be saved to a user database but cannot be manipulated any further after the film is applied.

Glazing Systems

- Multilayer glazing systems are no longer limited to five layers (glazing slots). A glazing system can consist of any number of layers.
- The user may now change the gap width. The same gap width is used between all layers in the schematic view. Gap width does not affect optical properties.
- Glazing systems are now saved to the user database as type "Glazing system." This type of glazing and the type "Interlayer" cannot be exported to WINDOW 5.1. Saved glazing systems can be re-loaded and edited later.

Continued on the next page

WINDOW 5.1, THERM 5.1 and Optics 5.1 -- Updates and Enhancements

Continued

WINDOW 5.1 Features, Corrections, Changes

Glazing System Library

- Added a tab in the Results section for Angular Data.
- Added a Glazing System Report (similar to that in WINDOW 4.1) that includes both the angular dependence table and the temperature information.
- Added damage-weighted UV Transmittance calculations for both Krochman and ISO methodologies

Glass Library

- Implemented a *checksum* feature, at both glass layer import and also at calculation time, which checks to see that the spectral data in the Glass Library has not been altered from that of the International Glazing Database. If the checksum does not compute correctly, WINDOW will automatically remove the # value.
- Conductivity of the glass layers from the International Glazing Database has been set to 1.0. This will minimally change the U-factor calculations.
- When importing records from the International Glazing Database, the IGDB version number is displayed.
- Reads Optics 5.1-format databases.
- Added ability to change the ID of a record imported from the Optics5 user database.
- Changed what the program prepends in the Source field when importing records:
    - importing from the International Glazing Database prepends “IDGB < db version #>” and
    - importing from an Optics5 user database prepends “IGDB User.”

Gas Library

- The gas properties reported in the DOE-2 report are now correct.

Frame Library

- The THERM file paths are now relative to the currently open database (MDB) file.
- Improved the speed of importing THERM files.
- Fixed a problem for Microsoft Windows XP and 2000 operating systems that caused a large increase in memory use when importing THERM files.
- Fixed a crash when going from the List View to the Detail View.

Optics 5.1 Features, Corrections, Changes

Laminates

- The laminate editor is no longer a separate program. Creating new laminates from existing components can be done in Optics 5.1.
- It is now possible to create laminates with embedded coatings, i.e., coatings on a glass layer next to an interlayer. This can only be done when the coating manufacturer has supplied enough information to allow Optics 5.1 to perform such an operation.
- Laminates are no longer limited to six layers; a laminate can consist of any number of layers.
- The program supplies improved feedback when the user tries to create an invalid laminate (e.g., when trying to combine two rigid layers without an interlayer).

Databases

- Optics 5.1 only works with the International Glazing Database (IGDB) version 12.3 and higher.
- The glazings are automatically sorted into groups that show the possible operation that can be done; for example:
    - Embedded coatings are grouped under a tab called 'Embedded coatings.'
    - When applying a new coating to a glazing, Optics 5.1 will only show the new coatings that can be used for this operation.
- It is now possible to switch between multiple user databases.
- A 'Find' feature has been added to quickly find glazings by their filename, NFRC_ID, product name, etc.
- The glazing type "interlayer" has been added.
- Reference laminates that are used to calculate interlayer data, but that have missing or incomplete structure information, are not shown in the database.

Standards - Wavelength Sets

- The default standard is called "W5_NFRC_2003." This standard is to be applied for NFRC rating purposes and supercedes the older standards. All values in the database are calculated with the "W5_NFRC_2003" standard. Other standards that are still supported are: "CRI," "ISO_9050" and "prEN_410." The RADIANCE standard is used internally to export RADIANCE text files.

Continued on the next page

WINDOW 5.1, THERM 5.1 and Optics 5.1 -- Updates and Enhancements

Continued

THERM 5.1

THERM models two-dimensional heat-transfer effects in building components such as windows, walls, foundations, roofs, doors, appliances and other products where thermal bridges are a concern. THERM allows you to evaluate a product's energy efficiency and local temperature patterns, which may relate directly to problems with condensation, moisture damage, and structural integrity.

Updates from THERM 5.0 to THERM 5.1

In General

- Program no longer requires that the simulation results be saved in order to import the CR results into WINDOW 5.1.
- Fixed several problems that had resulted in program crashes.

Frame Cavities

- Added the ability to change emissivities for any boundary segment in a frame cavity.

Boundary Conditions

- Program now picks up the emissivity values for the boundary conditions from the adjacent materials.
- Improvements in boundary condition generation, particularly when existing boundary conditions have been changed or deleted. Program now has three options to pick from when generating boundary conditions to accommodate all the possibilities.

THERM 5.1 may be downloaded from http://windows.lbl.gov/software/therm/therm.html.
If you download THERM 5.1, and you also use the WINDOW program, you should also download WINDOW 5.1.

Optics 5.1 Features, Corrections, Changes

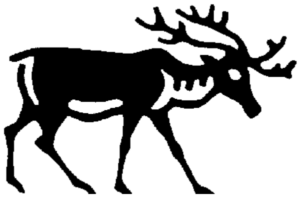
- The only and default wavelength set that is used is "Optics5." This wavelength set is similar to the one that is required according to the data submission procedures of the International Glazing Database.
- A second wavelength set ("Color 5nm") is only used internally by Optics 5. 1 to calculate photopic properties according to certain standards that require this wavelength set.

User interface

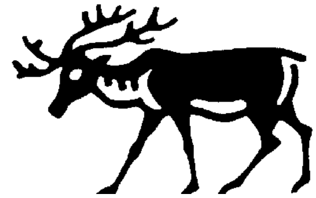
- Improved feedback in the form of tooltips.
- Warns when a calculation results in errors or when results are less reliable due to lack of information. Warnings are listed per wavelength and can be exported to a text file for further analysis.
- OLE-drag-and-drop from the database to the glazing slots and to other programs.
- Quick link to the internet to check for the latest version of the International Glazing Database.
- The database grid uses bookmarks to automatically look up the most recent selected glazing in the database grid.

Removed Features

- For the time being, the program is no longer supporting the calculation of angle dependent properties. In a future version of Optics, angle dependent calculations will probably be re-instated in a different form, giving the spectral averaged properties as a function of the angle of incidence.
- Optics is no longer supporting thermal calculations (U-value, SHG-value). These calculations were incorporated by request for a quick comparison. However, other software, such as WINDOW 5.1, may be used to calculate the thermal properties.
- Some older wavelength sets have been removed. Optics still supports the use of various wavelength sets for experienced users; however, these are no longer distributed with the program in order to avoid confusion about the use of these sets.
- The installation package no longer supports Windows 95. Microsoft stopped its official support for Windows 95 and, since some programming components no longer support Windows95, it was decided that we could no longer support installation on a Windows 95 platform. You can still install Optics on a Windows 95 system, which will usually work out fine, but it is not supported officially.



DOE-2



DOE-2.1E (v. 119) 1,000-Zone version for Windows from ESTSC; other vendors of DOE-2 based programs are listed on our website: http://SimulationResearch.lbl.gov > DOE-2

Cost is as follows:

$ 300	U.S. Government, non-profit Educational
$ 575	U.S., Mexico, Canada
$ 1268	Japan only
$ 1075	All Other Non-U.S.

DOE-2 Documentation on a CD from ESTSC - Cost US$100

What is included on the CD?

- DOE-2 Reference Manual (Part 1)
- DOE-2 Reference Manual (Part 2)
- DOE-2 BDL Summary (2.1E)
- DOE-2 Engineers Manual (2.1A)
- DOE-2 Supplement to the Reference Manual (2.1E)

Order Software and ESTSC Documentation

Ed Kidd
NCI Information Systems, Inc.
Energy Science and Technology Software Center (ESTSC)
P.O. Box 1020
Oak Ridge, TN 37831

Phone: 865/576-1037
Fax: 865/576-6436
Email: estsc@adonis.osti.gov

Purchase DOE-2 Documentation

DOE-2 Sample Run Book (2.1E) -- The Sample Run book is the only remaining DOE-2 manual not available electronically. It must be purchased separately from NTIS; information is at http://SimulationResearch.lbl.gov > DOE-2 > Documentation

Free DOE-2 Documentation (http://SimulationResearch.lbl.gov > DOE-2 > Documentation)

- DOE-2 Basics (2.1E)
- Update Package #1:
  DOE-2.1E Basics, the Supplement and BDL Summary
- Update Package #2: (Version 107, DOE-2.1E) BDL Summary and Supplement.

DOE-2 Basics and Update Packages 1, 2, 3 and 4 are not included on the ESTSC CD. They consist of scanned pdf files and may be downloaded from our web site. You may also request the same information on a CD by sending email to klellington@lbl.gov.

The update files need to be printed and the update pages inserted into the existing DOE-2 manuals.

DOE-2 listings are continued on the next page

--Continued—

Free DOE-2 Documentation (http://SimulationResearch.lbl.gov > DOE-2 > Documentation)

- Update Package #3:
  Appendix A of the Supplement.
- Update Package #4: (1000-zone DOE-2.1E) BDL Summary.
- DOE-2 Modeling Tips (pdf)

Note that the Update Packages are **not** cumulative and each one contains different information. You have to download all four packages to update the DOE-2 documentation completely.

DOE-2 Modeling Tips is a compilation of all the "how to" articles from the *Building Energy Simulation User News* (through 2001).

DOE-2 Training Private or group DOE-2 courses for beginning and advanced users:
Contact Marlin Addison at (602) 968-2040, marlin.addison@doe2.com

DOE-2 Help Desk

Email, phone or fax the Simulation Research Group with your questions (klellington@lbl.gov).
Phone: (510) 486-5711, Fax: (510) 486-4089

Recent changes to DOE-2.1E are described. Shown at the left is the version number of DOE-2.1E, which is incremented for each change. Following is a short description of the changes, the initials of the author and date of change. Note that each version of DOE-2.1E includes all changes made up to and including that version number. Therefore, Version -120 includes all prior changes. You can determine which version of the program you are using by checking any of the output reports, where version *nnn* is indicated as DOE-2.1E-*nnn*.

-120 : bdl dkey

Fix number overflow in line number field of the BDL OUTPUT file . [EE 11/06/2002]

Increase the limit for weighting-factor commands from 128 to 1024. The limit of 128 causes BDL to give error messages when the number of spaces with custom weighting factors is greater than 128. [EE 11/06/2002]

From the Building Energy Simulation User News, Vol. 19, No. 1 (Spring 1998)
Revised, Vol. 23, No. 6 (November/December 2002)

UNDERGROUND SURFACES: HOW TO GET A BETTER UNDERGROUND SURFACE HEAT TRANSFER CALCULATION IN DOE-2.1E

by
Fred Winkelmann

Note: The Spring 1998 issue (Vol. 19, No. 1) of the Building Energy Simulation User News described a simplified method for modeling foundation heat flows in DOE-2. The article contained three tables giving the perimeter conductance per perimeter foot for slab, basement, and crawl space conditions calculated using a two-dimensional finite-difference program*. The basic approach in this simplified procedure was to model the true foundation area as an underground surface[s], and add a fictitious insulating layer to the outside of the surface[s] so that the total foundation conductance equals the perimeter length times the perimeter conductance given in Tables 1, 2, and 3. For basements, the article recommended that the floor be modeled as an UNDERGROUND-FLOOR with zero conductance, and the walls as an UNDERGROUND-WALL with a conductance calculated as just described. It has been brought to our attention that this method presents a problem in some uninsulated basement cases where the required wall conductance may be greater than that of the basement wall, e.g., 4" concrete and 1 ft. of soil, without adding any insulating layer. In such instances the solution is to also model the basement floor as a heat transfer surface and then to add the same insulating layer to both so that the total foundation conductance from both equals the perimeter length times the conductance shown in Table 3.

Joe Huang and Jeff Warner, LBNL, October 2002

* Y.J. Huang, L. Shen, J. Bull, and L. Goldberg, "Whole-House Simulation of Foundation Heat Flows Using the DOE-2.1C Program", ASHRAE Transactions 94(2), 1988.

Underground surfaces in DOE-2.1E are walls or floors that are in contact with the ground. An example is a slab-on-grade or a basement wall. Underground surfaces are entered using the UNDERGROUND-WALL command, or the equivalent command, UNDERGROUND-FLOOR. Check the description of these commands in the *Reference Manual* for information on the keywords for these surfaces.

Heat Transfer

Care needs to be taken in describing the construction of an underground surface in order to get a correct calculation of the heat transfer through the surface and a correct accounting for the thermal mass of the surface, which is important in the weighting factor calculation for the space. In the LOADS program, DOE-2 calculates the heat transfer through the underground surface as

$$Q = UA(T_g - T_i)$$

where U is the conductance of the surface, A is the surface area, T_g is the ground temperature and T_i is the inside air temperature. *If the raw U-value of the surface is used in this expression the heat transfer will be grossly overcalculated.* This is because the heat transfer occurs mainly through the surface's exposed perimeter region (since this region has relatively short heat flow paths to the outside air) rather than uniformly over the whole area of the surface. For this reason, users are asked to specify an effective U-value with the U-EFFECTIVE keyword. This gives

$$Q = [\text{U-EFFECTIVE}]*A(T_g - T_i)$$

In general U-EFFECTIVE is much less than the raw U-value.

The following procedure shows how to determine U-EFFECTIVE for different foundation configurations. It also shows how to define an effective construction for an underground surface that properly accounts for its thermal mass when custom weighting factors are specified. The procedure assumes that the monthly ground temperature is the average outside air temperature delayed by three months, which is similar to how the ground temperatures on the weather file are calculated. To force the program to use the weather file values, do *not* enter ground temperatures using the GROUND-T keyword in the BUILDING-LOCATION command.

Procedure for defining the underground surface construction

1. Choose a value of the perimeter conduction factor, *F2*, from Table 1, 2 or 3 for the configuration that best matches the type of surface (slab floor, basement wall, crawl-space wall), foundation depth and amount and/or location of insulation.

2. Using *F2*, calculate R_{eff}, the *effective resistance* of the underground surface, which is defined by the following equation:

   $R_{eff} = A / (F2 * P_{exp})$

   where *A* is the area of the surface (ft^2 or m^2) and P_{exp} is the length (ft or m) of the surface's perimeter that is exposed to the outside air. Figures 1 and 2 show values of P_{exp} for example foundation configurations. If P_{exp} is zero[**], set R_{eff} to a large value, e.g. R_{eff} = 1000.

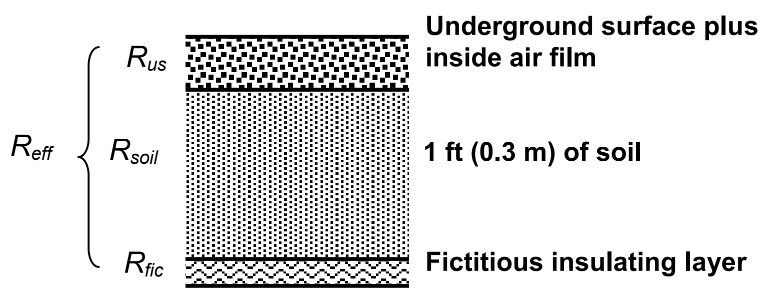
3. Set U-EFFECTIVE = $1/R_{eff}$.

   The program will calculate the heat transfer through the underground surface to be

   $Q = [U\text{-}EFFECTIVE] * A\ (T_g - T_i)$

4. Define a construction, shown in the figure below, consisting of the following:

   - The underground wall or floor, including carpeting, if present, and inside film resistance (overall resistance = R_{us})
   - A 1-ft (0.3-m) layer of soil (resistance = R_{soil} = 1.0 hr-ft^2-F/Btu [0.18 m^2-K/W])
   - A fictitious insulating layer (resistance = R_{fic})



The layer of a soil represents the thermal mass of the ground in contact with the underground surface (a 1-ft [0.3-m] layer is sufficient to account for most of the thermal mass effect). The fictitious insulating layer is required to give the correct effective resistance for the construction, i.e.

$R_{eff} = R_{us} + R_{soil} + R_{fic}$

From this we get

$R_{fic} = R_{eff} – R_{us} – R_{soil}$

The procedure for defining this construction is shown in the following example.

** The procedure makes the approximation that the heat transfer through an underground surface with no exposed perimeter, such as a basement floor, is zero.

Example: 50' x 100' slab-on-grade.

The slab consists of uncarpeted, 4-in (10-cm) heavy-weight concrete (CC03 in the DOE-2.1E library), with resistance = 0.44 hr-ft^2-F/Btu (0.078 m^2-K/W). The foundation depth is 4 ft (1.22 m) with R-10 (1.76 m^2-K/W) exterior insulation, which gives F2 = 0.50 Btu/hr-F-ft (0.86 W/m-K) from Table 1. We then have:

Slab surface area:	A = 50x100 = 5000 ft^2
Slab exposed perimeter:	P_{exp} = (2x50) + (2x100) = 300 ft
Effective slab resistance:	$R_{eff} = A/(F2*P_{exp})$ = 5000/(0.90*300) = 33.3
Effective slab U-value:	U-EFFECTIVE = 1/R_{eff} = 0.030
Actual slab resistance:	R_{us} = 0.44 + R_{film} = 0.44 + 0.77 = 1.21
Resistance of fictitious layer:	$R_{fic} = R_{eff} – R_{us} – R_{soil} = 33.3 – 1.21 – 1.0 = 31.1$

Here, 0.77 hr-ft^2-F/Btu (0.14 m^2-K/W) is the average of the air film resistance for heat flow up— 0.61 hr-ft^2-F/Btu (0.11 m^2-K/W)—and heat flow down— 0.92 hr-ft^2-F/Btu (0.16 m^2-K/W). For vertical surfaces, such as basement walls, you can use R_{film} = 0.68 hr-ft^2-F/Btu (0.12 m^2-K/W).

The input would look like:

```
$ Slab-on-grade $
MAT-FIC-1  = MATERIAL  RESISTANCE = 31.1  .. $ the Rfic value
SOIL-12IN = MATERIAL  THICKNESS = 1.0  CONDUCTIVITY = 1.0
                      DENSITY = 115  SPECIFIC-HEAT = 0.1 ..

LAY-SLAB-1 = LAYERS  MATERIAL = (MAT-FIC-1,SOIL-12IN,CC03)
                     INSIDE-FILM-RES = 0.77 ..

CON-SLAB-1 = CONSTRUCTION LAYERS = LAY-SLAB-1 ..
  .
  .
SLAB-1 = UNDERGROUND-FLOOR HEIGHT = 50
                           WIDTH = 100
                           TILT = 180
                           U-EFFECTIVE = 0.030
                           CONSTRUCTION = CON-SLAB-1 ..
```

Caution: If you change the dimensions of the slab later, be sure to recalculate R_{fic}. For example, if the 50x100-ft slab is changed to 50x80-ft exposed perimeter becomes 260-ft, and we get R_{eff} = 4000/(0.50*260) = 30.8 (rather than 33.3), U-EFFECTIVE = 1/30.8 = 0.033 (rather than 0.030), and R_{fic} = 30.8 – 1.21 – 1.0 = 28.6 (rather than 31.1).

Note (1):

For basements (Table 2) and crawl spaces (Table 3) an 8-in (20.3-cm) high section between ground level and the top of the underground wall is included in the F2 calculation and so does not have to be entered as a separate exterior wall. However, for shallow basements (Table 2) the wall section between the top of the underground wall and main level of the building should be entered as a separate exterior wall.

Note (2):

The floor of a crawl space (Table 3) should be entered as an UNDERGROUND-FLOOR consisting of a 1-ft (0.3-m) layer of soil with a fictitious insulation layer underneath it. Because the exposed perimeter of the floor in this case is zero, the heat transfer is zero, so the fictitious insulation layer should have a very high resistance and U-EFFECTIVE should be close to zero. The input would look like:

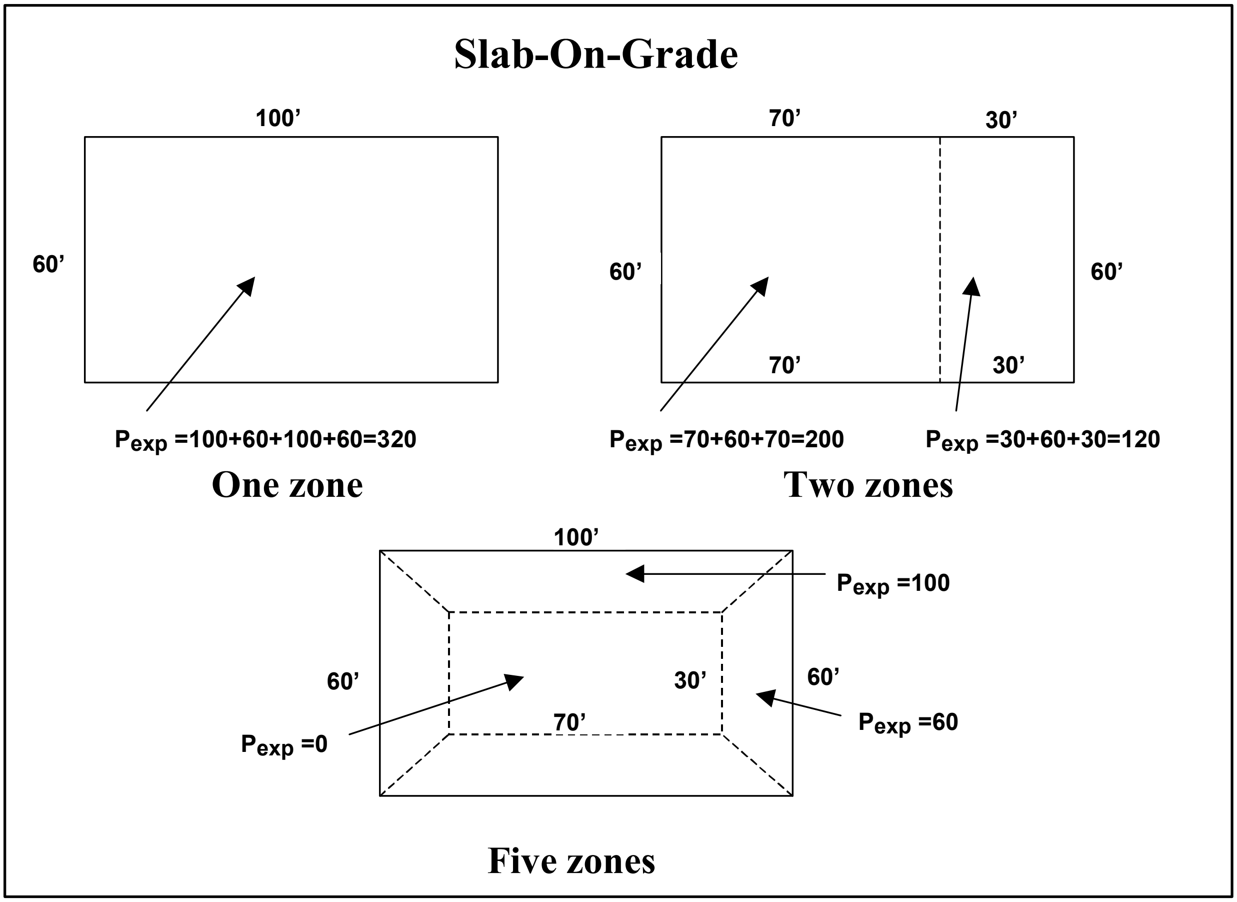
```
$ Crawl space floor $
MAT-FIC-1  = MATERIAL RESISTANCE = 1000  ..
SOIL-12IN = MATERIAL  THICKNESS = 1.0
                      CONDUCTIVITY = 1.0
                      DENSITY = 115
```

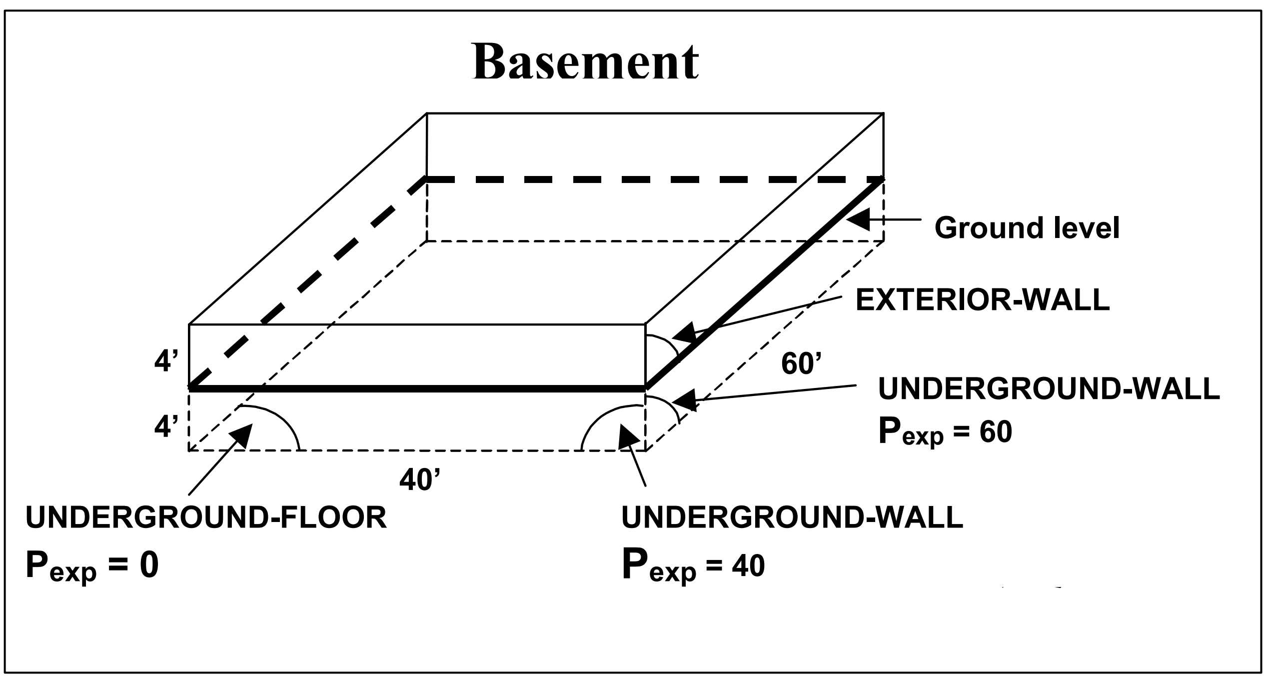
```
                         SPECIFIC-HEAT = 0.1 ..

LAY-FLOOR-1 = LAYERS  MATERIAL = (MAT-FIC-1, SOIL-12IN)
                      INSIDE-FILM-RES = 0.77 ..

CON-FLOOR-1 = CONSTRUCTION LAYERS = LAY-FLOOR-1 ..
 ....
FLOOR-1 = UNDERGROUND-FLOOR HEIGHT = 50
                            WIDTH = 100
                            TILT = 180
                            U-EFFECTIVE = 0.001
                            CONSTRUCTION = CON-SLAB-1 ..
```

Thermal Mass

Underground surfaces are usually concrete and therefore have high thermal mass. Because of its heat storage capacity, this mass attenuates loads due to heat gains (from lights, solar, people, etc.) and causes a time delay between when the heat gain occurs and when it appears as a load on the HVAC system. In general, the higher the heat capacity and the more closely coupled the mass is to the room air, the larger this delay and attenuation will be.

DOE-2 will account for thermal mass only if (1) the underground surface is entered with a layers-type construction, following the procedure described in the previous section; and (2) custom weighting factors are calculated for the space, i.e., FLOOR-WEIGHT = 0 in the SPACE or SPACE-CONDITIONS command.





Exposed perimeter calculation for slab-on-grade examples.

Table 1: Perimeter Conduction Factors for Concrete Slab-On-Grade*

Slab-On-Grade			
Foundation depth	**Insulation Configuration (see sketch for location of insulation)**	**PERIM-CONDUCT Btu/hr-F-ft (W/m-K)**	
		Uncarpeted	**Carpeted**
2 ft	Uninsulated	1.10 (1.90)	0.77 (1.33)
	R-5 exterior	0.73 (1.26)	0.54 (0.93)
	R-10 exterior	0.65 (1.12)	0.49 (0.85)
	R-5 interior; R-5 gap	0.75 (1.30)	0.57 (0.98)
	R-10 interior	0.89 (1.54)	0.46 (0.79)
	R-10 interior; R-5 gap	0.70 (1.21)	0.53 (0.92)
	R-10 interior; R-10 gap	0.68 (1.17)	0.52 (0.90)
	R-5 2-ft perimeter; R-5 gap	0.78 (1.35)	0.60 (1.04)
	R-10 2-ft perimeter; R-5 gap	0.73 (1.26)	0.57 (0.98)
	R-10 4-ft perimeter	0.79 (1.36)	0.59 (1.02)
	R-10 15-ft perimeter, R-5 gap	0.39 (0.67)	0.34 (0.59)
	R-5 16-in exterior, R-5 2-ft horizontal	0.65 (1.12)	0.48 (0.83)
	R-5 16-in exterior, R-5 4-ft horizontal	0.58 (1.00)	0.43 (0.74)
	R-10 16-in exterior, R-5 2-ft horizontal	0.56 (0.97)	0.41 (0.71)
	R-10 16-in exterior, R-5 4-ft horizontal	0.47 (0.81)	0.35 (0.60)
4 ft	Uninsulated	1.10 (1.90)	0.77 (1.33)
	R-5 exterior	0.61 (1.05)	0.46 (0.79)
	R-10 exterior	0.50 (0.86)	0.37 (0.64)
	R-15 exterior	0.44 (0.76)	0.33 (0.57)
	R-20 exterior	0.40 (0.69)	0.30 (0.52)
	R-5 interior; R-5 gap	0.63 (1.09)	0.48 (0.83)
	R-10 interior; R-5 gap	0.54 (0.93)	0.42 (0.73)
	R-15 interior; R-5 gap	0.50 (0.86)	0.38 (0.66)
	R-20 interior; R-5 gap	0.47 (0.81)	0.36 (0.62)
	R-5 4-ft perimeter; R-5 gap	0.68 (1.17)	0.54 (0.93)
	R-10 4-ft perimeter; R-5 gap	0.61 (1.05)	0.49 (0.85)
	R-10 4-ft perimeter	0.79 (1.36)	0.59 (1.02)
	R-10 15-ft perimeter, R-5 gap	0.39 (0.67)	0.34 (0.59)
	R-5 16-in exterior, R-5 2-ft horizontal	0.65 (1.12)	0.48 (0.83)
	R-5 16-in exterior, R-5 4-ft horizontal	0.58 (1.00)	0.43 (0.74)
	R-10 16-in exterior, R-5 2-ft horizontal	0.56 (0.97)	0.41 (0.71)
	R-10 16-in exterior, R-5 4-ft horizontal	0.47 (0.81)	0.35 (0.60)

*Source: Y.J.Huang, L.S.Shen, J.C.Bull and L.F.Goldberg, “Whole-House Simulation of Foundation Heat Flows Using the DOE-2.1C Program,” ASHRAE Trans. 94 (2), 1988, updated by Y.J.Huang, private communication.

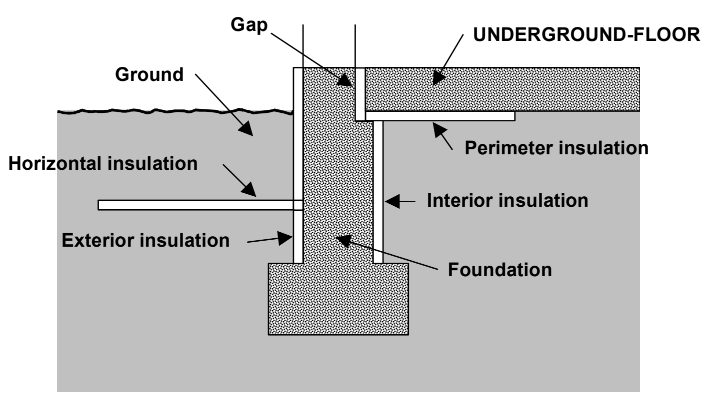
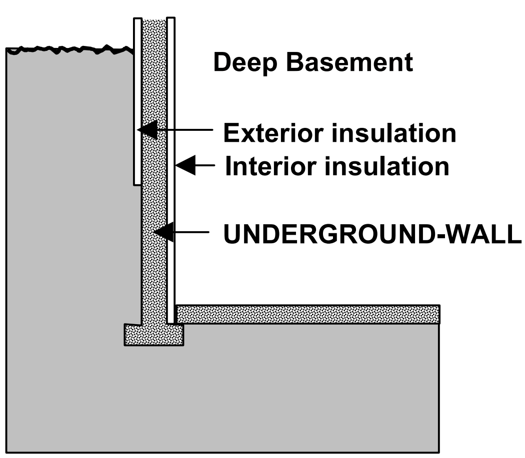


Table 2: Perimeter Conduction Factors for Basement Walls*

Basement Wall		
Underground Wall Height	**Construction (see sketch for location of insulation)**	**PERIM-CONDUCT Btu/hr-F-ft (W/m-K)**
8 ft (deep basement)	R-0 (uninsulated), concrete	1.94 (3.35)
	4-ft R-5 exterior, concrete	1.28 (2.21)
	8-ft R-5 exterior, concrete	0.99 (1.71)
	4-ft R-10 exterior, concrete	1.15 (1.99)
	8-ft R-10 exterior, concrete	0.75 (1.30)
	8-ft R-15 exterior, concrete	0.63 (1.09)
	8-ft R-20 exterior, concrete	0.56(0.97)
	8-ft R-10 interior, concrete	0.78 (1.35)
	R-0, wood frame	1.30 (2.25)
	R-11, wood frame	0.88 (1.52)
	R-19, wood frame	0.79 (1.37)
	R-30, wood frame	0.66 (1.14)
4 ft (shallow basement)	R-0 (uninsulated), concrete	1.61 (2.78)
	R-5 exterior, concrete	0.89 (1.54)
	R-10 exterior, concrete	0.73 (1.26)
	R-15 exterior, concrete	0.66 (1.14)
	R-20 exterior, concrete	0.65 (1.12)
	R-10 interior, concrete	0.79 (1.37)
	R-0, wood frame	1.10 (1.90)
	R-11, wood frame	0.80 (1.38)
	R-19, wood frame	0.74 (1.28)

*Source: Y.J.Huang, L.S.Shen, J.C.Bull and L.F.Goldberg, "Whole-House Simulation of Foundation Heat Flows Using the DOE-2.1C Program," ASHRAE Trans. 94 (2), 1988, updated by Y.J. Huang, private communication.



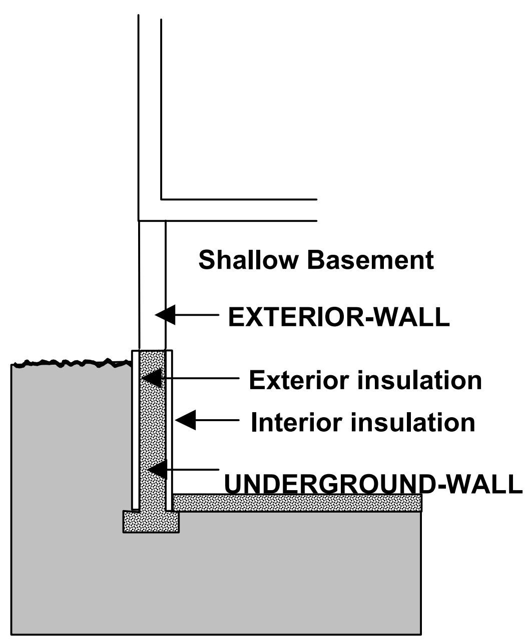
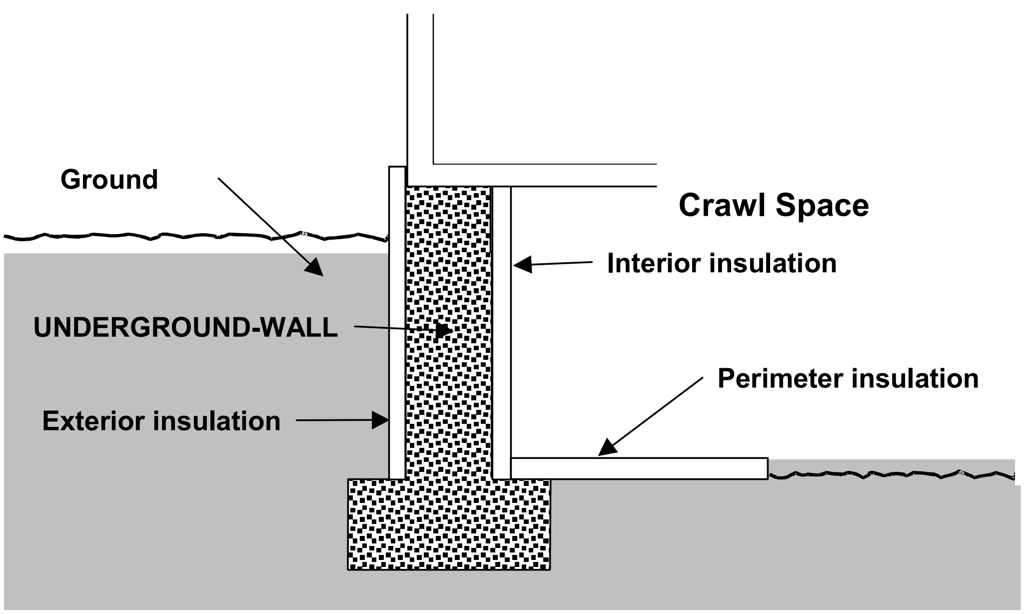


Table 3: Perimeter Conduction Factors for Crawl Space Walls*

Crawl Space Wall		
Wall Height	**Construction (see sketch for location of insulation)**	**PERIM-CONDUCT Btu/hr-F-ft (W/m-K)**
2 ft	R-0 (uninsulated), concrete	1.29 (2.23)
	R-5 exterior, concrete	0.93 (1.61)
	R-10 exterior, concrete	0.87 (1.95)
	R-5 interior, concrete	0.97 (1.50)
	R-10 interior, concrete	0.91 (1.57)
	R-5 interior; R-5 4-ft perimeter, concrete	0.73 (1.26)
	R-10 interior; R-10 4-ft perimeter, concrete	0.68 (1.18)
	R-0, wood frame	1.00 (1.73)
	R-11, wood frame	0.88 (1.52)
	R-19, wood frame	0.86 (1.49)
4 ft	R-0 (uninsulated), concrete	1.28 (2.21)
	R-5 exterior, concrete	0.71 (1.23)
	R-10 exterior, concrete	0.59 (1.02)
	R-15 exterior, concrete	0.54 (0.93)
	R-20 exterior, concrete	0.50 (0.86)
	R-5 interior; R-5 4-ft perimeter, concrete	0.64 (1.11)
	R-10 interior; R-10 4-ft perimeter, concrete	0.58 (1.00)
	R-0, wood frame	0.83 (1.44)
	R-11, wood frame	0.59 (1.02)
	R-19, wood frame	0.55 (0.95)

**Source: Y.J.Huang, L.S.Shen, J.C.Bull and L.F.Goldberg, "Whole-House Simulation of Foundation Heat Flows Using the DOE-2.1C Program," ASHRAE Trans. 94 (2), 1988, updated by Y.J. Huang, private communication.*



ENERGY-10, VERSION 1.5

ENERGY-10 is a design tool for smaller residential or commercial buildings that are less than 10,000 ft^2 or buildings that can be treated as 1- or 2-zone increments. It performs whole-building energy analysis for 8760 hours/year, including dynamic thermal and daylighting calculations. ENERGY-10 was specifically designed to facilitate the evaluation of energy-efficient building features in the very early stages of the design process.

Version 1.5 Upgrades

Life Cycle Costs

A whole new capability is included to evaluate life-cycle costs. The year-by-year cash flow of the building is determined and discounted to the present value. The difference between Bldg-1 and Bldg-2 is determined in terms of net present value, NPV (the difference in life-cycle costs), internal rate of return, benefit-to cost ratio, or simple payback.

Up-to-date compiler

The entire program has been ported to 32-bit and (with the exception of the CNE thermal simulation engine) programmed in Visual C++ 6.0, the current Microsoft compiler. One benefit that users will appreciate is that it is no longer necessary to close ENERGY-10 before starting a new project.

More Wall Layers

In previous versions, you were restricted to 6 layers in a wall construction. This has now been expanded by 3, giving you the opportunity to define a 7-layer wall plus two air films.

New Graphs

Graphs are programmed in a new and powerful graphing package (Olectra).

New Reports

A Cost Summary report tabulates the results of the life cycle cost evaluation. An HVAC and EES Cost report details the components of HVAC cost and each of the EES costs. A Peak Loads report identifies the peak loads and corresponding HVAC rated capacities for the AutoSize calculations and also the peak loads and consumptions during the annual simulation showing when the peaks occurred.

Building Energy Software from Lawrence Berkeley National Laboratory

Free Downloads	
BDA 2.0 (Building Design Advisor) *A beta version of 3.0 is available from vpal@lbl.gov*	**gaia.lbl.gov/BDA**
COMIS (multi-zone air flow and contaminant transport model)	**www-epb.lbl.gov/comis**
EnergyPlus **1.0.1** (new-generation whole-building energy analysis program, based on BLAST and DOE-2)	**www.energyplus.gov** --or-- **SimulationResearch.lbl.gov > EnergyPlus**
GenOpt®**1.1.2** (generic optimization program)	**SimulationResearch.lbl.gov > GenOpt**
RADIANCE (analysis and visualization of lighting in design) ***Desktop Radiance*** (integrates the Radiance Synthetic Imaging System with AutoCAD Release 14)	**radsite.lbl.gov/radiance/** **radsite.lbl.gov/deskrad/**
RESEM (Retrofit Energy Savings Estimation Model) (calculates long-term energy savings directly from actual utility data)	**eetd.lbl.gov/btp/resem.htm**
SUPERLITE (calculates illuminance distribution for room geometries)	**eetd.lbl.gov/btp/superlite2.html**
THERM 2.1a (models two-dimensional heat-transfer effects in building components where thermal bridges are of concern)	**windows.lbl.gov/software/therm/therm.html**
VisualSPARK 1.0.1 (Simulation Problem Analysis and Research Kernel) (connect component models to simulate innovative building envelope and HVAC systems)	**SimulationResearch.lbl.gov > VisualSPARK**
WINDOW 5 (thermal analysis of window products)	**windows.lbl.gov/software/window/window.html**
Free Software / Request by Fax from 510.486.4089	
RESFEN 3.1 (choose energy-efficient, cost-effective windows for a given residential application)	**windows.lbl.gov/software/resfen/resfen.html**
Web Based	
Home Energy Saver (quickly computes home energy use) and ***Home Improvement Tool*** (simplified Home Energy Saver)	**hes.lbl.gov** and **hit.lbl.gov**
Purchase	
ADELINE 2.0 (daylighting performance in complex spaces)	**radsite.lbl.gov/adeline/**

BLAST*news*

www.bso.uiuc.edu

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The **Building Loads Analysis and System Thermodynamics (BLAST** program predicts energy consumption, energy system performance and cost for new or existing (pre-retrofit) buildings.

BLAST contains three major sub-programs:

- **Space Load Prediction** computes hourly space loads in a building based on weather data and user inputs detailing the building construction and operation.
- **Air Distribution System Simulation** uses the computed space loads, weather data, and user inputs.
- **Central Plant Simulation** computes monthly and annual fuel and electrical power consumption.

Heat Balance Loads Calculator (HBLC)
The BLAST graphical interface (HBLC) is a Windows-based interactive program for producing BLAST input files. You can download a demo version of HBLC (for MS Windows) from the BLAST web site (User manual included).

HBLC/BLAST Training Courses
Experience with the HBLC and the BLAST family of programs has shown that new users can benefit from a session of structured training with the software. The Building Systems Laboratory offers such training courses on an as needed basis typically at our offices in Urbana, Illinois.

WINLCCID 98
LCCID (Life Cycle Cost in Design) was developed to perform Life Cycle Cost Analyses (LCCA) for the Department of Defense and their contractors.

To order BLAST-related products, contact the Building Systems Laboratory at the address above.

Program Name	Order Number	Price
PC BLAST Includes: BLAST, HBLC, BTEXT, WIFE, CHILLER, Report Writer, Report Writer File Generator, Comfort Report program, Weather File Reporting Program, Control Profile Macros for Lotus or Symphony, and the Design Week Program. The package is on a single CD-ROM and includes soft copies of the BLAST Manual, 65 technical articles and theses related to BLAST, nearly 400 processed weather files with a browsing engine, and complete source code for BLAST, HBLC, etc. Requires an IBM PC 486/Pentium II or compatible running MS Windows 95/98/NT.	3B486E3-0898	$1500
PC BLAST Package Upgrade from level 295+	4B486E3-0898	$450
WINLCCID 98: executable version for 386/486/Pentium	3LCC3-0898	$295
WINLCCID 98: update from WINLCCID 97	4LCC3-0898	$195

The last four digits of the catalog number indicate the month and year the item was released or published. This will enable you to see if you have the most recent version. All software will be shipped on 3.5" high density floppy disks unless noted otherwise.